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ABSTRACT

In this project, a plan for solving word problems based on the students' level of development was developed. A 10-week implementation of a plan for solving word problems at the concrete level of development included the use of a flow chart or plan to map out and solve word problems. Students then used the flow chart and manipulatives to develop and write word problems of their own, in large group and small group situations. Results of the post-test showed that the students' ability to solve word problems improved through the use of this implementation plan. Twenty-four third grade students in the target group demonstrated the ability to solve word problems as evidenced in average to above average stanines in Math and Reading Comprehension on the Stanford Achievement Test. Included in this document are the purpose of the project, a brief literature review, a discussion of the methods used, results, and recommendations. Appended are surveys, tests, and correspondence. (CW)

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ED325382

# INCREASING STUDENTS' ABILITIES TO SOLVE WORD PROBLEMS THROUGH CONCRETE AND PROBLEM WRITING EXPERIENCES

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by

Lynne M. Bray

A Practicum Report
submitted to the Faculty of the Center for the
the Advancement of Education of Nova University in partial
fulfillment of the requirements for the degree of Master
of Science

The abstract of this report may be placed in the School Practices Information Files for reference.

June, 1988

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ABSTRACT

Increasing Students' Abilities to Solve Word Problems Through Concrete and Problem Writing Experiences.

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Twenty-four third grade students in the target group have the ability to solve word problems as evidenced in the average to above average stanines in Math and Reading Comprehension on the Stanford Achievement Test. Students experience difficulty in solving word problems as evidenced by scores below 80 percent on the word problems section of the State Assessment Test and the teacher-made word problems' test. Both teachers and students indicated on a survey that students experience difficulty solving word problems. The writer developed a plan for solving word problems based on the students' level of development. According to Piaget, students in third grade are in the Concrete Operational Stage. At this stage students experience difficulty with word problems which are abstract. Students in the concrete stage need concrete experiences. A ten week implementation of a concrete plan for solving word problems included the use of a flow chart or plan to map out and solve word problems. Students then used the flow chart and manipulatives to develop and write word problems of their own, in large and small group situations. Results of a post-test show that 100 percent of the students' ability to solve word problems improved through the implementation plan.

AUTHORSHIP STATEMENT

I hereby testify that this paper and the work it reports are entirely my own. Where it has been necessary to draw from the work of others, published or unpublished. I have acknowledged such work in accordance with accepted scholarly and editorial practice. I give this testimony freely, out of respect for the scholarship of other workers in the field and in the hope that my work presented here will earn similar respect.

Signed Lynne M. Bray

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Practicum Title Increasing Students' Abilities to Solve Word Problems Through Concrete and Problem Writing Experiences

Student's Name Lynne Bray

Program Site H.L. Johnson Elementary School Date June 1988

Observer's Name Eleanor Mainor Eleanor Mainor
(please print---------and sign)

Observer's position Teacher; TEC Rep. Phone # 793-4392

Observer's comment on impact of the project (handwritten):

I observed Mrs. Bray implementing her practicum with participation from each student in her class.

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# Chapter I

## Purpose

### Background

The site of this practicum is an elementary school built four years ago, consisting of kindergarten through fifth grades. The school's enrollment is currently 1,570. The community has a population of 11,500. The population of the school and community are increasing almost daily, due to continuous growth and construction of new homes. Due to this constant growth and movement, the student population is a mobile one.

The community is a middle class suburb, located west of a city. Most of the residents work at least 30 to 60 minutes away from the community. At least 60 percent of the students' mothers work outside the home. As a result, the school has a before and after school childcare program with an enrollment of 400. The school and community have a racial mix of seven percent minority population.

The school consists of 57 regular classes. The school's staff is actively concerned with meeting student needs. Students whose needs are not being met in the regular classroom are recommended by the child study team for Exceptional Student Education classes. These include Emotionally Handicapped, Speech and Language, Specific Learning Disabilities, Gifted, and Drop-out Prevention.

The school is part of a county system in which a Unified

Curriculum is used in all subject areas. The Unified Curriculum includes the use of specific textbooks and workbooks, and county-developed testing materials. Pupil progression to the next grade is dependent on mastery of basic skills in the areas of reading and math. Students in the target group make up a regular third grade class within the school. In grade three, the basic skills are tested using the State Assessment Test.

The writer is presently the instructor in a regular third grade class. The writer's experience includes teaching five years in the second grade, one year in the fourth grade, one year in the seventh and eighth grade, and four years in the third grade. Teaching the grades preceding and following third grade has given the writer an insight into the total picture of what is expected at different grade levels.

The writer lives in the community where the school is located. Living in the community has given the writer a feel for the students and their backgrounds. The writer also participates in both school and community projects.

The writer's philosophy of education consists of leading the child to independence in thinking by developing skills and study habits which will carry over to the next grade. The writer feels it is very important to lead the child to the point where the child can take his ideas and express them through verbal and written modes. The writer believes that students learn a great deal by participating in cooperative groups. The writer

also believes that a positive or negative self-concept relates to the learning, or lack of learning, as the case may be. The writer is committed to excellence in the total education of each child in the classroom.

## Problem Statement

A lack of effective teaching strategies for instruction in solving word problems can be seen in the target group. This is evidenced by a discrepancy in the target students' abilities to do word problems as seen in the results of the Stanford Achievement Test in the areas of reading and math; and the students' failure to work word problems as seen in the results of the State Assessment Test. In addition, the teacher survey, student survey, and teacher-made pretest indicate that students are having difficulty solving word problems.

The students' stanines on the Stanford Achievement Test indicate that each child in the target group is within the average to above average range in reading and math achievement (Appendix A). Test scores indicate that students should be able to do word problems that are within their ability level (Thredgill-Sowder and Moyer, 1984).

The school participated in a self study leading to its initial accreditation by the Southern Association of Colleges and Schools in 1984-1985. In the mathematics section of the self study, under plans for improvement, the school staff indi-

cated that additional improvements were needed in techniques necessary for teaching problem solving. A specific plan for effectively teaching techniques for solving word problems is needed.

In the fall, students in the target group took the Florida State Student Assessment Test. The results of this test show that the class scored 62 percent in solving real-life word problems. The expected score, according to the county standards, is 80 percent.

On the teacher-made pretest (Appendix B) consisting of various types of word problems, four students scored above 80 percent, with the other 19 students scoring below 80 percent. The mean score on the test was 62.60 percent. Of the two types of errors, computation and choosing the correct operation, the majority of the errors were in choosing the correct operation (Appendix A).

Results of a student survey (Appendix C) show that students do not like working word problems. Various reasons for this attitude includes: "word problems are too hard", students don't know whether to add, subtract, multiply or divide. Students felt the teacher could help them by doing the word problems with them or by helping them choose which operation to use.

A teacher survey (Appendix D) was given to 60 teachers, with 38 teachers responding. The results (Appendix E) show that most teachers think more emphasis should be placed on word problem solving. The majority of the respondents must retest math mastery

tests relating to word problems. Teachers felt that most of the difficulty students experience with word problems is in the areas of reading the problem, choosing the correct operation, and understanding the language of the word problems. One-third of the respondents felt that their students did not enjoy solving word problems.

The writer has observed students in the target group experiencing difficulty solving word problems. When nonroutine problems with various operations are assigned, students are confused with the problems and require teacher help.

The writer discussed the problem and implementation plan with the principal of the school. The principal was enthusiastic and encouraged the writer in the implementation plan (Appendix F).

## Outcome Objectives

1. Over a period of ten weeks 100 percent of the students in the target group will improve their ability to solve word problems with 80 percent accuracy as measured by the difference between the scores on the teacher-made test before and after the treatments.

2. Over a period of ten weeks the students in the target group will improve their ability to choose the correct operation with 80 percent accuracy as measured by the number of errors in choosing the operation on the pretest and post-test.

3. Over a period of ten weeks 100 percent of the students

in the target group will show a more positive attitude toward, and a greater confidence in, their ability to solve word problems as evidenced by the results of the student survey filled out by the students before and after the treatments.

Chapter II

Research & Solution Strategy

**Research**

Learning to solve word problems is one of the most valuable skills to be gained in studying arithmetic, not so much as a goal of mathematical instruction, but as a starting point towards problem solving ability and the ability to apply and use mathematics. The results of the National Assessment of Educational Progress (NAEP) in 1972 and 1973, concluded, "we suspect that solving word problems has not been part of the mathematics program for many nine year olds " (Carpenter, Coburn, Reys, and Wilson, 1976:389). The call for emphasis on the teaching of problem solving skills apparently went unheeded because, in 1978, the NAEP called for renewed emphasis on teaching problem solving. The NAEP revealed in their report that respondents demonstrated a lack of even basic problem solving skills (Le Blanc, 1982).

Reports conducted by Aiken in 1971 and Barnett in 1979, concluded that teacher's experience suggests that the ability to solve word problems is related to the ability to read. Looking for evidence to support this premise, Moyer (1982, 1983) conducted tests in reading comprehension and solving word problems. In order to form a correlation between the two subjects, he administered the TORC test in reading comprehension and tests involving word problems. At each grade level, grades three through seven, Moyer found that students who scored above the mean on the TORC

test had significantly higher scores on the word problem tests than students who scored below the mean on the TORC (Thredgill-Sowder and Moyer, 1984). These results indicate that children scoring at or above the mean in reading comprehension should be able to solve word problems without difficulty.

Research emphasizes the importance of the amount of time spent in the instruction and working of word problems. Teachers can bring about improved scores in problem solving by making problem solving a regular part of the mathematics instruction. Polya, in a study in 1973, found that the teacher who wants to develop a student's ability to work word problems must create some interest for problems in the student's mind and must provide plenty of opportunity for imitation and practice (Carpenter, Coburn, Reys, and Wilson, 1976).

One problem elementary students have with word problems is their inability to think abstractly. Word problems are abstract in that they involve the ability to visualize what cannot be seen. Story problems are abstract in that they involve the ability to understand verbal statements and make propositions (Burns, Richardson, 1981). Solving story problems is too abstract for young children because they do not come from the children's experiences (Reutzel, 1983). According to Piaget, the ability to reason abstractly can only occur when students enter the stage of Formal Operations, which begins when the child is 11.

The textbook organization assumes that students can naturally

make the jump from practicing a particular operation and applying it in word problems (Burns, 1986). Applying the operation involves abstract thinking. Children in the primary elementary grades cannot make this jump because they are developing through the stage of Concrete Operational Thought. Children at this age can only understand what they see and experience. At this stage, children must use manipulatives in order to learn by doing. Children must be given the opportunity to work the story problems with actual objects in front of them.

According to Piaget, children in this stage must develop schemas, which are general ways of thinking about or interacting with ideas and objects in the environment (Berger, 1980:55). Children have the need to develop plans and routines that can be repeated in similar situations. Teachers fill this need by providing a problem solving organization that can be repeated. Teachers can give the students a plan for solving word problems and encourage students to use the plan each time a word problem is solved. The plan should include a way to identify and put data in a proper sequence and to specify a particular operation (Reutzel, 1983). Using a "map" will help the students identify the parts of the problem after looking at the whole problem.

Research suggests that students should write the equation or number sentence. Seeing a written product shows the teacher and the student what was done to solve the problem (Hollander,

1977). Another effective strategy is to have the students write the answer in a complete sentence. For students involved in solving word problems, the process of writing sentences to answer questions helps identify difficulties by focusing the student's attention on the question they have had to answer (Van Devender, 1987).

Research has suggested that the student's involvement in the writing of story problems can lead the child to generalize for himself, through his experiences, the language patterns of the operations (Burns, Richardson, 1981). By developing problems on their own, and sharing these problems with their peers, students gradually move from concrete to more abstract language and components that they encounter in textbook word problems (Reutzel, 1983). Having students make up applications helps them bridge the gap between concrete situations and mathematical abstractions (Wirtz and Kahr, 1982).

Reading teachers know that a child who is having trouble in reading can read, without any trouble, a story that the child and the teacher have developed together. This ability is due to a high level of motivation resulting from pride of ownership and the child's familiarity with the words he has chosen for the story. This same pride of ownership and familiarity with vocabulary can also be accomplished when elementary students write their own mathematical word problems (Muller and Kurtz, 1981). In writing word problems using the language experience approach, children

are given the experience of writing their own problems, in their own language, using their own experiences (Davidson, 1977).

In problem solving, students must recall previously-learned operations and select the appropriate plan for solving a specific type of problem. Often, a student may become fixed on one particular aspect of a problem or solution path and fails to recognize the gestalt or total picture (Moses, 1982). In order to prevent the child from becoming fixed on one operation, the teacher must provide experiences where numerous solving procedures involving all operations are modeled for the student. This can be done using the overhead, chalkboard, worksheets, large group or small group experiences.

Using groups for math has been shown to be effective. It may be that with-in class grouping increases achievement by reducing the size of the instruction groups or by structuring the teacher's instructional time more effectively (Slavin, 1987:321). One grouping method is cooperative grouping. In cooperative grouping, student instruction and practice takes place in small, mixed-ability groups. Research on cooperative groups has found that, at the present time, cooperative learning groups appear to have the greatest potential as a method of grouping students (Slavin, 1987).

Throughout the research, one ingredient for successful problem solving stood out, that is teacher involvement. The teacher who wishes to develop students' abilities to solve word problems must be willing to become actively involved in the developmental process.

Simply assigning the word problems will not be enough.

**Solution Strategies**

Relying on previously-established research, the writer decided upon the following solution strategies:

Students were provided with daily experiences in a developmental approach to problem solving. The developmental approach relied on providing concrete experiences that led the child through the stages of problem solving.

One concrete approach was the development and use of a problem solving plan. The procedure included the development and use of a flow chart for recording the problem solution (Appendix G). Using the flow chart as a model, students looked at the word problem as a whole and wrote the parts of the problem. In the beginning stages, the students identified the data and question of each word problem, using those sections of the flow chart.

Concrete manipulatives were then introduced. These included the students, furniture in the room, money, a restaurant menu, stuffed animals, fruit, blocks, shells, and any manipulatives that could be found. These were used as the writer modeled the story and operations of an addition, subtraction, multiplication and division problem. The writer used the manipulatives to show the different kinds of word problems using the four operations. With each example, the students used the flow chart to identify the data and question.

The writer began to involve the students in the writing of story problems using the manipulatives and the language experience approach. The writer introduced the manipulative, then modeled or had a student model an operation. The writer asked students to tell a story about the action they saw. The writer then wrote the story on the board as the students described what had happened by interacting with the manipulatives. The students at their seats used the flow chart to record the story for themselves.

Using the same approach, the 24 students were divided into one of eight groups. Students were not ability grouped, but groups were based on the cooperative learning approach to grouping. Students from the group of four that scored 80 percent or better on the pretest assisted other students in varous groups when needed.

The groups used manipulatives to develop story problems. These story problems were written down and worked together as a group. Students in the group used the flow chart plan to identify the plan, question, and operation. On the flow chart, students wrote the number sentence or equation, showing how the problem was solved. The students worked the problem in the space provided on the flow chart. Students then took the data, question, and numerical answer and wrote the answer in a sentence. This enabled the students to check their response against the problem components.

As this process continued, the development of a problem solving technique was practiced.

The writer chose these strategies because each one was supported by research. Piaget's research on the Concrete Operational Stage has provided the writer with the underlying strategy. There is a need for concrete experiences at this level of development. The strategy, which includes the use and development of a problem solving plan or "schema", is the use of a flow chart. Students used the flow chart to look at the whole problem and identify the parts of the problem. This whole-to-part approach is another concrete experience. Each time a problem was worked, the flow chart plan or schema was used to enable students to develop a plan which could be used in future problem solving situations.

The use of manipulatives is another concrete experience. Students were able to experience a story problem by doing what the story states. According to Piaget, at this stage students learn by doing.

The writer chose to use the flow chart and manipulatives in having the students write story problems. Research showed that through the concrete experience of writing and doing story problems, students are able to work abstract textbook problems.

The writer had students work in groups because grouping was shown to be an effective means of practice and instruction. The writer also has seen that students enjoy working and interacting in groups.

Chapter III

Methodology

## Methods

A daily 30 minute time period was set aside for the word problem experiences. The time set aside for the problem solving activities was during the regular class center time. The teacher-directed activities were followed by the regular math instruction time. Additional exercises relating to the daily activities were placed in a math center, where students were permitted to work on their own or in small groups.

The strategies outlined were presented and practiced in two week intervals. The first strategy presented was writer-directed in which the students used a partial flow chart to identify the data and question parts of a word problem. The second writer-directed strategy involved the use of a flow chart to actually identify the parts of and solve word problems. The third strategy had the students writing stories for mathematical manipulations that the writer demonstrated and working the problems using the flow chart plan. The first, second, and third writer-directed steps lead to the final strategy in which students worked independently, in groups of three, writing and working story problems using manipulatives and the flow chart plan. Groups then exchanged word problems, worked each others' problems using the flow chart plan, then rated each others' problems. Each strategy built on the previous strategy, and developed into the next strategy.

The teacher observer was invited to observe each of the strategies (Appendix H).

Step One

The object of Step One was to have students look at the whole problem and identify the parts of the problem. The writer accomplished this whole-to-part strategy by involving students in identifying the data and question part of the word problem. Students were given a worksheet which contained five word problems. The writer led a discussion into the parts of a word problem. Students discovered that every word problem must contain data and a question. The writer then had a student read the first word problem. Students were asked to identify the data, then the question for that word problem. The writer wrote the data in a "data box" and question in the "question box" on the chalkboard. Beneath each problem on the worksheets, students drew boxes and copied the data and question in the correct boxes.

Each day for the two week period of time, five of these whole-to-part activities were worked. On each worksheet the writer used five different types of word problems. The daily word problems' worksheet contained problems involving each of the operations, including: addition, subtraction, multiplication, division, and comparison. The writer used varied operations in order to expose students to many types of word problems.

Following the Step One activities, the writer administered a "quick quiz" consisting of ten mixed operation one-step word problems (Appendix I). The quiz was given to see if the students' ability to successfully solve word problems improved using the Step One strategy. On the last day of Step One, the teacher

observer was invited to observe the class activities (Appendix J).

Step Two

The object of Step Two was to give students a plan to follow for solving word problems. During weeks three and four, the writer accomplished this by having students use a flow chart plan to solve word problems. On day one, each student was given a sample flow chart. The flow chart had spaces provided for the data, question, sentence answer, operation, and equation. With sample flow charts in front of each student, the writer began a discussion into the parts of the flow chart. Students easily understood the data and question parts as these were previously covered in Step One.

The writer led the students in a discussion into the meaning of the term "operation" as it is used in math. The writer asked the students to identify each of the operations used in math. As each one was identified, the writer asked the students to explain the mechanics of each operation. The students' attention was then focused on the equation box of the flow chart. The writer led the students in a discussion of the parts of an equation. The writer explained that in order to properly work a word problem an equation should be written and worked. The writer then directed the students to the sentence answer section of the flow chart. The writer explained to the students that a word problem question should be rearranged into a sentence. After the problem is worked,

the sentence answer should be examined to see if it makes sense in the relationship to the data and question.

Students were then given a worksheet containing five mixed operation word problems. Students also received a sheet containing five flow charts. The writer asked students to read a word problem. The writer asked the students to identify the data and question. As the writer wrote the data and question on the board flow chart, students wrote the same information on one of the flow charts at their seats. The writer then directed students to the question. Students were asked to rearrange the question into a sentence. Students wrote the sentence in the "sentence answer" section of the flow chart. The writer then led the students in a discussion of the data and question. The students discussed the problem and what was being asked for. The writer and the students discussed how to solve the problem. Students then chose the operation and wrote the symbol for that operation in the "operation" section of the flow chart. Students were then asked to write an equation using the data and operation. Students wrote the equation in the equation box on the flow chart. Lastly, students took the answer from the equation box and placed it in the sentence answer. The writer and students discussed the sentence answer, determining if the answer made sense.

During weeks three and four, the daily activity consisted of the writer and students solving five word problems using the plan outlined above. Following Step Two activities, students

were given a "quick quiz" consisting of ten one-step mixed operation word problems (Appendix K). The results of the quiz were used by the writer to judge the effectiveness of the Step Two activities. On the last day of week four, the teacher observer was invited to watch the Step Two activities (Appendix L).

Step Three

The object of Step Three included the use of concrete manipulation as a way of creating and solving word problems. The writer accomplished Step Three during weeks five and six by having students use manipulatives and the flow chart plan to write and solve story problems. During each of the Step Three activities, the writer began by drawing a flow chart on the board. Students drew an original flow chart on their papers. Each day five flow charts were drawn to accommodate the five story problems that were developed. The writer introduced Step Three by modeling an operation using manipulatives. Using the language experience approach, the writer asked students to tell a story of what they saw. The writer copied the story on the blackboard in the data box of the flow chart. Students were then asked to develop a question which was recorded in the question box of the flow chart. The writer then directed the students to rearrange the question to form a sentence answer, which was written in the sentence answer section of the flow chart. Students were then asked to identify the operation, write an equation, and work the problem in the respective boxes on the flow charts. Students were encouraged to write

creative stories concerning the demonstration modeled by the writer. Students were permitted to read the stories written. Each time a story problem was demonstrated, students used the flow chart to write and work the problem.

Each day for weeks five and six, the writer presented five different scenes using manipulatives. Each scene demonstrated one problem showing addition, subtraction, multiplication, division, and comparison problems. With each demonstration the above process was repeated.

During weeks five and six, the manipulatives and paper were available in a math center. Students were encouraged to create story problems using the manipulatives and the flow chart plan. The writer provided a "share time" when students read story problem creations to the class.

On the last day of week six, the teacher observer was invited to observe the Step Three activities (Appendix M). Following the two week practice of Step Three, the writer gave a "quick quiz" consisting of ten mixed operation one-step word problems (Appendix N). The quiz was given to see if the Step Three strategy improved the students' ability to solve word problems.

**Step Four**

The object of Step Four, which took place during week seven and eight, was to have students write their creative word problems. The 24 students were divided into groups of three. Each group had a student helper. The helper in each group came from the

group of students scoring 80 percent or better on the teacher-made pretest. Each day a group leader was responsible for obtaining materials for the other team members. Each student in the group had a worksheet and a writing instrument, and each group had a manipulative.

On day one of Step Four, the writer asked each group to write an addition story problem using the manipulative chosen by the group. Students were told to write the problem in the data section and develop a question in the question section on the flow chart. Group members then used the flow chart to develop a sentence answer, choose an operation, and work the problem in the equation section of the flow chart. After the students had written an addition, subtraction, multiplication, division, and comparison problem using the above strategy, students would conference with the writer. The writer discussed the story problems with the students, asking how the problem was developed and why it was solved the way it was. After conferencing with the writer, students then copied the word problems onto 3X5 cards using colored markers. Each group made a decorative bag in which the story problem cards were placed.

Following week eight, the teacher observer was invited to observe one session of activities which demonstrated Step Four strategy (Appendix O). Students were then given the final "quick quiz" (Appendix P). The writer used the result of the quick quiz to determine whether Step Four had improved students' problem solving abilities.

Each day during week seven and eight, students created word problems, conferenced with the writer, copied the story problems onto cards, and placed the cards in group bags. During weeks nine and ten, students exchanged bags with other groups. Students worked each others' problems using the flow chart plan. After working the problems, groups would then rate the problems according to creativity and workability.

During week nine, students began to create a booklet which outlined and illustrated the four steps taken to "take the problem out of problem solving." Each group developed a booklet, parts of which were used to create a class booklet (Appendix Q). Students illustrated, colored, and copied their favorite story problems in the booklets. Students distributed the booklets to students in other classes.

During the final weeks, the writer began to develop a videotape showing the students demonstrating the four strategy steps. During the last week, students were videotaped participating in each of the strategy steps. Students viewed the videotape.

Each student participated in making a post-test consisting of 20 mixed operation one-step word problems (Appendix R). Each student filled out the teacher-made survey concerning word problems.

**Materials**

The following materials were utilized: various manipulatives chosen by the writer or the students; tagboard, a bag for each group, markers, crayons, pencils, chalkboard and chalk, and, flow

charts. A videotape camera and machine were used to videotape the four strategy steps.

**Monitoring**

The writer monitored progress through direct contact with the students. The writer circulated when the groups were working to see that the members were cooperating and each member was participating. The writer also monitored progress by examining the flow charts that each student filled out with the working of each problem. The writer also looked at the quality of the story problems that were written by each group or individuals in the group. The writer asked questions of the students in the groups. The responses to these questions gave the writer an idea of the progress that was made.

The writer stayed attuned to what was occurring in each group by circulating and direct contact with each group. The writer either worked directly with students experiencing difficulty, or assigned a team member to work directly with any student experiencing difficulty. The writer moved students to different groups when it was necessary to do so.

**Evaluation Plan**

The writer administered the teacher-made pretest to the target group. After ten weeks of implementation, the target group received a teacher-made post-test. The results of this test were compared to the results of the pretest to see how much gain was

achieved by the target group. The errors in choosing the correct operation were also tallied and compared to see how much improvement was achieved in this area.

The target group filled out a survey concerning working word problems. The results of this survey showed that the majority of students disliked working word problems and had trouble knowing how to work the problems. After ten weeks of treatment, the writer had the students fill out the same survey to see if students' attitudes toward solving word problems had become more positive, and if students had developed more confidence in solving word problems.

Every two weeks an additional strategy was added to the previous one. The effectiveness of the strategy introduced was measured by a series of "quick quizzes." Every two weeks, a "quick quiz" consisting of ten one-step word problems was taken by the target group. The results of these quizzes showed the writer the effectiveness of each strategy.

## Chapter IV

## Results

The writer implemented a four-step strategy plan for the purpose of improving the following: 1. Students' ability to solve word problems; 2. Students' ability to choose the correct operation; 3. Students' attitude toward and confidence in solving word problems. The overall results were clearly seen through the comparison of the pretest and post-test results, four "quick quizzes", and a student survey filled out by students before and after the treatments.

### Objective One

A comparison of the results of the pretest and post-test show that students' ability to solve word problems did improve. Objective One states that over a period of ten weeks 100 percent of the students in the target group would improve their ability to solve word problems with 80 percent accuracy as measured by the difference between the scores on the teacher-made test before and after the treatments. One-hundred percent of the students in the target group improved in their abilities to solve word problems. According to the data of the post-test, 22 of the 24 students, or 92 percent of the target, were able to solve word problems with 80 percent accuracy (Appendix S).

The writer implemented a four-step strategy plan. Each step lasted two weeks. The writer administered a "quick quiz" at the

end of each step to determine the effectiveness of the implemented step. The results of the "quick quizzes" are as follows:

**Step One:** Identifying the data and question parts of a word problem. The results of Quick Quiz One, administered after Step One, show improvement in students' abilities to solve word problems (Appendix S). The results show that 11 students, or 45 percent of the target group, improved in their abilities to solve word problems. Through treatment one, eight students, or 33 percent of the students, were able to solve word problems with 80 percent accuracy.

**Step Two:** Using the flow chart plan to solve word problems. The results of Quick Quiz Two, administered after Step Two, show improvement in students' abilities to solve word problems (Appendix S). The results show that nine students, or 38 percent of the target group, improved in their ability to solve word problems. Through treatment two, ten students, or 42 percent of the students, were able to solve word problems with 80 percent accuracy.

**Step Three:** Using manipulatives and the flow chart plan to write and solve word problems using the language experience approach. The results of Quick Quiz Three, administered after Step Three, show improvement in students' abilities to solve word problems (Appendix S). The results show that 20 students, or 83 percent of the target group, improved in their ability to solve word problems. Through the treatment, 17 students, or 71 percent of the students, were able to solve word problems with 80 percent accuracy.

Step Four: Writing, solving, and rating each others' story problems in small groups. The results of Quick Quiz Four show improvement in students' ability to solve word problems (Appendix S). The results show that 21 students, or 80 percent of the target group, improved in their ability to solve word problems. Through treatment four, 22 students, or 92 percent of the students were able to solve word problems with 80 percent accuracy.

The results of the "quick quizzes" confirm that it was at Steps Three and Four that students' abilities to solve word problems began to show improvement. The use of manipulatives to create story problems and the use of the flow chart to map out and solve the story problem creations sparked improvement. The writer feels that by writing the different types of story problems, students were able to see for themselves how the different types of problems were put together. By working the problems using the flow chart plan, students were given a certain plan to follow each time a problem was worked.

## Objective Two

A comparison of the results of the pretest and post-test show that students' ability to choose the correct operation did improve (Appendix S). Objective Two states that over a period of ten weeks the students in the target group would improve their ability to choose the correct operation with 80 percent accuracy as measured by the number of errors in choosing the operation on the pretest and post-test.

Twenty-two of the 24 students, or 92 percent of the students in the target group, were able to choose the correct operation with 80 percent accuracy. The writer found that while 92 percent of the students achieved the goal of 80 percent accuracy, 100 percent did show improvement in their ability to choose the correct operation.

The writer implemented a four-step strategy plan. Each step lasted two weeks. The writer administered a "quick quiz" at the end of each step to determine the effectiveness of the implemented plan. The results of the "quick quizzes" are as follows:

Step One: Identifying the data and question parts of a word problem. The results of Quick Quiz One, administered after Step One, showed improvement in the students' abilities to choose the correct operation (Appendix S). The results show that 20 students, or 83 percent of the target group, improved in their abilities to choose the correct operation. Through treatment one, eight students, or 33 percent of the students, were able to choose the correct operation with 80 percent accuracy.

Step Two: Using the flow chart plan to solve word problems. The results of Quick Quiz Two, administered after Step Two, show improvement in students' abilities to choose the correct operation (Appendix S). The results show that 19 students, or 79 percent of the target group, improved in their ability to choose the correct operation. Through the treatments, 17 of the students, or 71 percent of the students, were able to choose the correct

operation with 80 percent accuracy.

Step Three: Using manipulatives and the flow chart plan to write and solve word problems using the language experience approach. The results of Quick Quiz Three, administered after Step Three, show improvement in students' abilities to choose the correct operation (Appendix S). The results show that 22 students, or 83 percent of the target group, improved in their ability to choose the correct operation. Through the treatment, 20 students, or 83 percent of the students, were able to choose the correct operation with 80 percent accuracy.

Step Four: Writing, solving, and rating each others' story problems in small groups. The results of Quick Quiz Four show improvement in student's abilities to choose the operation (Appendix S). The results show that 24 students, or 100 percent of the students in the target group, improved in their ability to choose the correct operation. Through the treatment, 22 students, or 92 percent of the students, were able to choose the correct operation with 80 percent accuracy.

Through the results of the "quick quizzes", the writer concluded that each step sparked an improvement in the students' abilities to choose the correct operation. Eighty percent accuracy in choosing the correct operation was accomplished at Steps Three and Four. The writer feels that both the use of manipulatives to write story problems and the use of a flow chart plan to work the problems helped students to choose the correct operation.

By manipulating objects, students saw the operation taking place. By having a section on the flow chart in which students had to look at the data and question and write the symbol for the operation they were using, students were aware of actually choosing an operation.

**Objective Three**

Objective Three states that over a period of ten weeks 100 percent of the students in the target group show a more positive attitude toward and a greater confidence in their ability to solve word problems as evidenced in the results of the student survey filled out by the students before and after the treatments.

It should be pointed out that changes in attitudes are difficult to calculate. Any change in attitude is a subjective opinion of the person observing the behavior. The writer attempted to determine changes in students' attitudes in two ways. The data that was analyzed was collected from a student survey that was filled out by each member of the target group both before and after the treatments. The writer also observed students' attitudes during the implementation process.

The results of the student survey after the implementation process clearly showed that 100 percent of the students enjoyed working word problems and feel confident that they are able to solve word problems. Students' attitudes during the implementation improved to the point that students thoroughly enjoyed creating

word problems. Students were writing word problems and working each others' word problems with great excitement. Students were eager to participate in the problems writing experiences and often asked when it would be time to do so.

The writer also observed that students were able to solve problems that appeared in the math textbook or on county-made mastery tests with greater ease. The writer in previous years had to retest the word problem section of a county-made mastery test. When the test was given this year, after the students participated in the implementation process, students passed the test the first time it was given, without having to take a retest.

The writer feels that each of the Four Steps led the students to success in problem solving because each step offered concrete experiences for the students. Each step built on the previous step and enabled the students to both utilize a problem solving plan and discover the parts of a word problem. Students were also given a daily problem solving time. The experience has led the writer to a discovery that students can enjoy the experiences they find most difficult, if the experience is brought down to the students' concrete level.

Chapter V

Recommendations

## Difficulties

The writer assumed that students knew how to work in small groups. Students' ideas of working in small groups included each person writing one problem, while the other children laughed or fooled around. The students needed a great deal of re-directing from the writer. Patience was needed on the part of the writer for at least one week, five days.

Students tended to write the same problems over and over again. For example, "John has six Lego's, Sue has five Lego's. How many more Lego's does John have?" and "John has six checkers, Sue has five checkers. How many more checkers does John have?" It took several days to instill the need for creativity in story problem writing. Students were motivated to write more creative problems through the critiquing process. Students had to exchange problems and rate each others' problems. The rating scale was as follows: 5=Excellent 4=Great 3=Good 2=Okay 1=Improvement Needed. Problems were rated according to the workability of the problem and how creative the problem was. The awareness that another group was rating their problems caused the students to write terrific story problems. Students were also more creative when they were trying to "stump" or "trip up" another group.

The writer also found that the students did not understand how to word the story problems. Students could manipulate the items, students could come up with an equation, but had the greatest

difficulty putting into words what was happening with the manipulatives. Students had the greatest difficulty working with multiplication and division stories. The writer found that the more practice the students had, the greater ease they found in writing their own word problems and working each other's problems.

Two students did not achieve the goal of 80 percent accuracy in the area of solving word problems and choosing the correct operation. The results of the quizzes and post-test indicate that although both students showed improvement, further one-on-one practice would be necessary to better develop their ability to solve word problems.

## Follow-On

The strategies outlined in this practicum could be utilized by any elementary math teacher. The writer sees the emphasis on problem solving as a future trend in education. With this emphasis occurring, teachers will be looking for strategies to both develop and improve the problem solving skills of their students.

At the conclusion of the implementation of this practicum, the writer plans to make solving word problems a part of each day. The solving of word problems could be implemented into either or both math and reading lessons.

The writer has shared the strategies outlined in this practicum with teachers within the school setting in two ways. The writer

prepared a videotaped presentation which presented the four strategy steps taken. The videotape was aired on the in-house television system in the school during the post-school planning day. Faculty members were encouraged to view the videotape. Many did watch the video and were anxious to learn more about the strategies used by the writer.

The writer also had the students prepare a booklet which illustrated the strategy steps that were taken to make problem solving easier for the students. The students wrote their favorite word problems at the end of the booklet for other students to solve. The booklets were distributed to each faculty member at the target school. Students also gave one booklet to a student in another class and took one booklet home.

The writer also shared the videotaped presentation and distributed the booklets to participants in the Gifted Child Module at Nova University. The writer was taking the course at the time and shared the implementation plan with fellow students.

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# APPENDIX A

## Target Class Results

| Student Number | Reading Stanine | Math Stanine | Pretest Number wrong | Pre-test Score | Errors in Computation | Errors in Operation |
|---|---|---|---|---|---|---|
| 1 | 9 | 6 | 8 | 60 | 1 | 7 |
| 2 | 9 | 7 | 1 | 95 | 0 | 1 |
| 3 | 5 | 7 | 6 | 70 | 1 | 5 |
| 4 | 6 | 7 | 4 | 80 | 2 | 2 |
| 5 | 5 | 5 | 14 | 30 | 1 | 13 |
| 6 | 7 | 8 | 5 | 75 | 2 | 3 |
| 7 | 7 | 6 | 4 | 80 | 1 | 4 |
| 8 | 7 | 9 | 2 | 90 | 0 | 2 |
| 9 | 6 | 6 | 7 | 65 | 2 | 5 |
| 10 | 9 | 7 | 3 | 85 | 1 | 2 |
| 11 | 6 | 6 | 8 | 60 | 1 | 7 |
| 12 | 8 | 5 | 5 | 75 | 2 | 3 |
| 13 | 4 | 5 | 12 | 40 | 3 | 9 |
| 14 | 5 | 6 | 5 | 75 | 1 | 4 |
| 15 | 5 | 5 | 13 | 35 | 2 | 11 |
| 16 | 5 | 7 | 7 | 65 | 3 | 4 |
| 17 | 6 | 5 | 12 | 40 | 3 | 9 |
| 18 | 5 | 6 | 8 | 60 | 3 | 5 |
| 19 | 5 | 7 | 5 | 75 | 2 | 3 |
| 20 | 4 | 7 | 7 | 65 | 3 | 4 |
| 21 | 4 | 7 | 13 | 35 | 2 | 11 |
| 22 | 6 | 4 | 14 | 30 | 3 | 11 |
| 23 | 6 | 8 | 5 | 75 | 4 | 1 |
| 24 | 7 | 8 | 6 | 70 | 4 | 2 |

APPENDIX B

Teacher-made Pretest

1. John has 137 baseball cards. Sue has 264 baseball cards. How many cards do they have in all?

2. There are 36 students going on a field trip. If only 4 students can go in each car, how many cars will be needed?

3. Jil has a stick of candy 12 inches long. Jennifer has a stick of candy 10 inches long. How much longer is Jill's candy than Jennifer's?

4. Tom ate 5 cheeseburgers. Bobby ate 6 cheeseburgers. How many cheeseburgers did they eat all together?

5. There are 24 children in the class. They have to get into 4 equal teams. How many children should be in each team?

6. The farmer planted watermelon seeds. He planted 6 rows with 6 seeds in each row. How many seeds did he plant?

7. Buddy has baseball practice at 4:00. He practices for 30 minutes. At what time does he finish baseball practice?

8. Joe's dog had 9 puppies. He gave 6 puppies to his friends. How many puppies does Joe have left?

9. The class store has 54 pieces of bubblegum. There are 6 pieces in each bag. How many bags are there?

10. Chris went to Burger King. He bought a cheeseburger for $.65, french fries for $.50, and a small Coke for $.60. How much did Chris spend at Burger King?

11. There were 4 baseball teams at the park. Each team had 6 baseballs. How many baseballs were there in all?

12. Bob weighs 95 pounds. Jim weighs 85 pounds. How much less does Jim weigh than Bob?

13. Ann went to the candy store. She bought 16 gummy bears, 3 candy bars, and 5 pieces of bubblegum. What is sum of the items she bought?

14. Jeff earned $9.00 for helping clean up the yard. He lost $2.00. How much money does he have now?

15. Tom went to the store to buy a new skateboard. It cost $12.00. He gave the clerk $20.00. How much change did he get?

16. There are 9 cars in the parking lot outside the store. If each car has four tires, how many tires do the 9 cars have?

17. Spot, the dog, is 47 inches long. Puff, the cat, is 24 inches long. How much shorter is Puff than Spot?

18. Ann has soccer practice at 5:00. It takes her 30 minutes to walk to practice. What time does Ann leave for practice?

19. Tara has 10 Cabbage Patch Kids. Christy has 11 Cabbage Patch Kids. How many Cabbage Patch Kids do they have together?

20. The red team scored 19 points. The green team scored 13 points. What is the difference between the scores?

APPENDIX C

Student Survey

Name _____

1. Do you like reading or math better?
2. Do you get better grades in reading or math?
3. Do you like math?
4. What is the best part of doing math?
5. What is the worst thing about doing math?
6. Do you like doing word problems?
7. Why don't you like doing word problems?
8. What could the teacher do to make word problems easier for you?
9. Do you like math homework?
10. Do you do better in math when someone helps you do it or when you do it alone?

APPENDIX D

cher Survey

SURVEY: PROBLEM SOLVING
Please take a little time and complete this survey . . .
RETURN TO LYNNE BRAY

1. What grade do you teach?_____

2. In which area of MATH do you find that you must do the most re-testing?
   a. computation
   b. word problems
   c. other_____

3. If you could pinpoint areas in solving word problems that give your students the most trouble, what would they be? (circle ALL the responses that apply)

   a. computation
   b. reading the problem
   c. choosing the correct operation
   d. writing the equation
   e. understanding the language
   f. lack of relevance to students
   g. other_____

4. How do you utilize the PROBLEM SOLVING WORKBOOK?
   a. Large Group Activity
   b. Individual Activity
   c. Small Group Activity
   d. Other

5. How many math groups do you have?

   1 2 3 4 5 other____

6. I think that MATH GROUPS are:
   a. necessary
   b. unnecessary
   c. other _____

7. Why or why not?

8. Do you think more emphasis should be placed on solving WORD PROBLEMS?
   a. Yes
   b. No
   c. Other _____

9. How often do you use manipulatives?
   a. Daily
   b. Weekly
   c. Other

10. What manipulatives do you use in teaching math?_____

11. What strategies for teaching word problems would be helpful to you?

12. Do your students enjoy working words problems:

a. yes
b. no
c. other_____

13. Helpful comments on teaching MATH WORD PROBLEMS:

Thank you,

Lynne Bray

APPENDIX E

Teacher Survey Results

SURVEY: PROBLEM SOLVING
Please take a little time and complete this survey .
RETURN TO LYNNE BRAY

1. What grade do you teach?_____

2. In which area of MATH do you find that you must do the most re-testing?
   a. computation 3
   b. word problems 25
   c. other: Fractions 1  Time 3  Greater/Less 1
      Money 7  Place Value 3

3. If you could pinpoint areas in solving word problems that give your students the most trouble, what would they be? (circle ALL the responses that apply)

   a. computation 3
   b. reading the problem 20
   c. choosing the correct operation 22
   d. writing the equation 12
   e. understanding the language 16
   f. lack of relevance to students 9
   g. other_____

4. How do you utilize the PROBLEM SOLVING WORKBOOK?
   a. Large Group Activity 27
   b. Individual Activity 6
   c. Small Group Activity 3
   d. Other Orally using manipulatives 1

5. How many math groups do you have?

   1 20  2 12  3 5  4 1  5 1  other____

6. I think that MATH GROUPS are:
   a. necessary 25
   b. unnecessary 6
   c. other _____

7. Why or why not? The students' level of development is not the same When students are having trouble; To see progress of students

8. Do you think more emphasis should be placed on solving WORD PROBLEMS?
   a. Yes 21
   b. No 12
   c. Other When introducing new concept 1

9. How often do you use manipulatives?
   a. Daily 15
   b. Weekly 8
   c. Other As needed 6

10. What manipulatives do you use in teaching math? bank, pictures store,band, rulers, clocks, sticks, students, buttons, pennies, clay, shapes

11. What strategies for teaching word problems would be helpful to you?

Relevant problems; Visuals,: Any and all; Word clues

12. Do your students enjoy working words problems:

a. yes 5
b. no 25
c. other ~~When doing together 5~~

13. Helpful comments on teaching MATH WORD PROBLEMS:

Make vocabulary easier
Used mixed problems, not just add or subtract on the page
Need a lot of emphsis on oral problems before written can be done
Act out problems
Use flow chart to do problems
Read orally
Cards that give clues for each operation

Thank you,

Lynne Bray

# H. L. JOHNSON COMMUNITY ELEMENTARY

100 Redwood Avenue
Royal Palm Beach, Florida 33411

ANN KILLETS
*Principal*

March 16, 1988

**TO:** Professors at Nova University

**FROM:** Ann Killets, Principal
H. L. Johnson Elementary AK

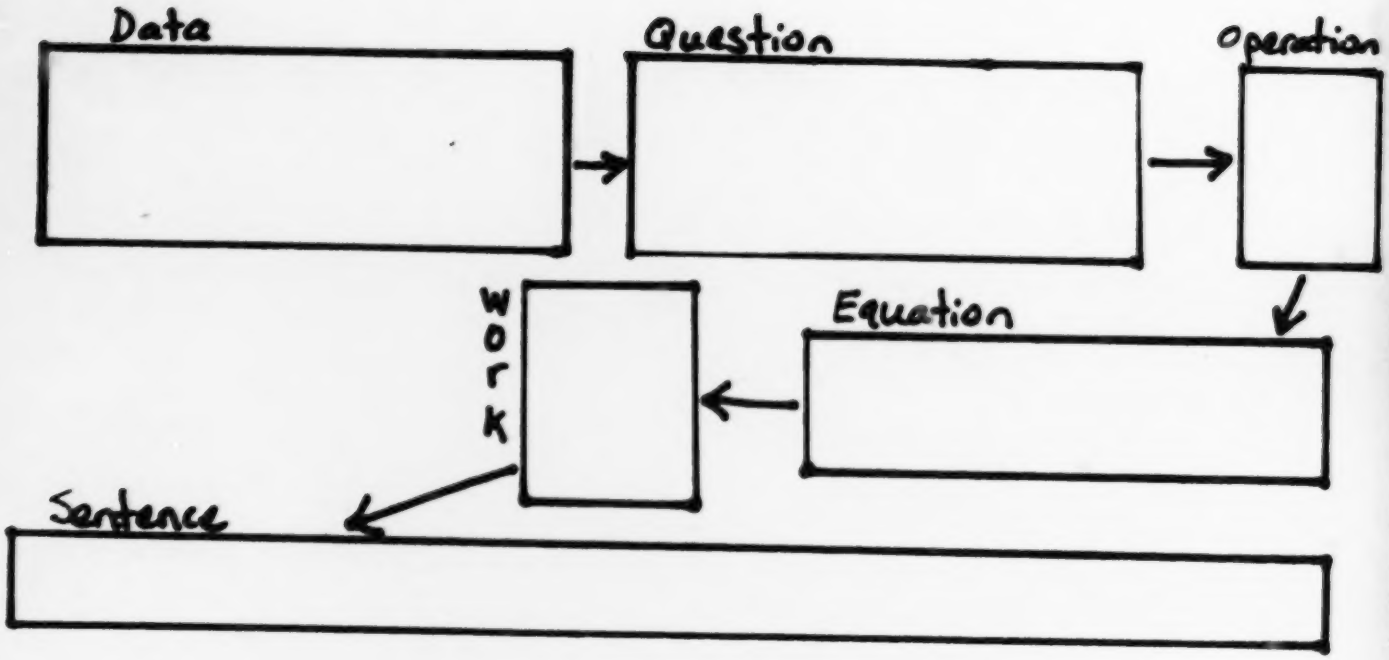
**RE:** Lynne Bray, Student

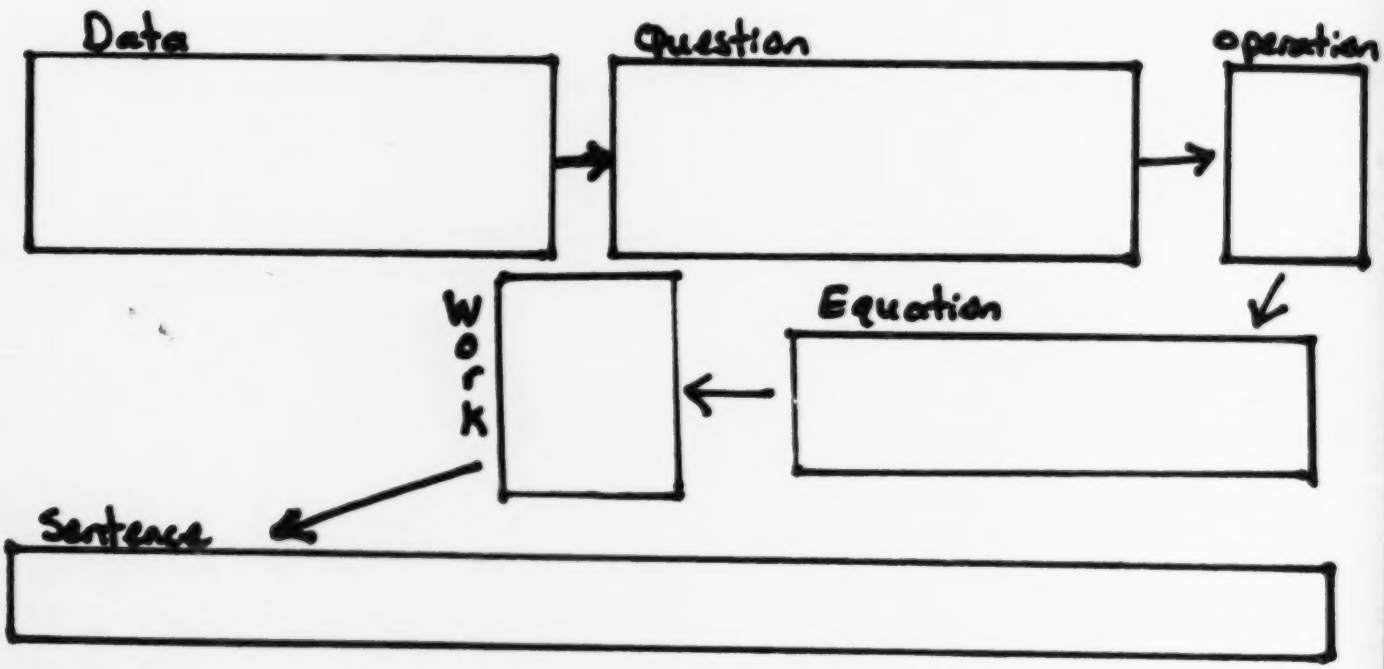
I found Lynne Bray's practicum to be quite professional and have given her authorization to implement her findings with her third grade class here at H. L. Johnson Elementary.

If I can be of assistance in any way, please let me know.

APPENDIX G

Sample Flow Chart



APPENDIX H

Observer Letter

March 14, 1988

To Whom It May Concern:

I, Eleanor Mainor, have agreed to be the observer of this practicum implementation. I have been informed of the need for this practicum and will observe the treatments outlined in the proposal.

Eleanor Mainor
signed

APPENDIX I

Quick Quiz/

1. Chris went to the store, he bought seven pencils, six erasers, and two markers. How many items did he buy?

2. Brian went to the candy store. He bought jellybeans for .$35. If he gave the clerk $1.00, how much change did he receive?

3. Christa planted watermelon seeds. She planted 5 rows of seeds with 7 seeds in each row. How many seeds did she plant?

4. The school store sold 30 pencils to 6 children, how many pencils did each child buy?

5. Amy has 37 pencils. Heather has 35 pencils. How many fewer pencils does Heather have than Amy?

6. Kevin weighs 64 pounds. Vincent weighs 66 pounds. What is the difference in their weight?

7. Tricia brought 14 flowers to school. She gave them to Mrs. Bray and Miss Orozco. How many flowers did each one receive?

8. There are nine boys in the class. Each boy has six books in his desk. How many books do the boys have?

9. The fishtank has 23 fish. 15 of the fish are goldfish, how many are not goldfish?

10. The two classes played kickball. 23 boys and 25 girls went out to play. How many children played kickball?

Observer Form

Date

April 6, 1988

Activity Observed

The class was presented a lesson on completing word problems using the "whole to part" method. Each student drew 2 bases under each problem and listed the important data in the first box and a question in the second box.

Comments

The lesson was well organized and presented in sequential steps. The use of the chalkboard by Mrs. Bray helped the students complete the worksheet successfully.

Observer

Eleanor Mainor
Third Grade Teacher
H. L. Johnson Elementary

APPENDIX K

Quick Quiz 2

1. There were 35 students in the class. If 18 students are buying lunch, how many students are not buying lunch?

2. The teacher brought in 40 pencils. If each student receives 2 pencils, how many students received pencils?

3. The children go to school for six hours each day. How many hours would they go to school in five days?

4. Heather had 54 marbles. If she gave 23 marbles to her sister, how many marbles does she have now?

5. Kevin had 50 marbles. His brother gave him 35 marbles. How many marbles does Kevin have now?

6. We saw 25 giraffes, 36 elephants, and 10 lions at the zoo How many animals did we see?

7. There were 36 elephants. Nine were babies. How many were not babies?

8. During the morning 25 giraffes were outside. After lunch, 9 giraffes went inside. How many giraffes were still outside after lunch?

9. The 36 elephants slept in six houses. How many elephants slept in each house?

10. Each of the 8 monkeys ate five bananas a day. How many bananas did the monkeys each each day?

APPENDIX L

Observer Form

Date

April 26, 1988

Activity Observed

Using a flow chart to work story problems. Students identified data and question in each story problem.

Comments

Excellent Lesson!

Observer

Eleanor Mainor
H. L. Johnson Elementary
Royal Palm Beach, Fl. 33411

APPENDIX M

Observer Role

Date

Activity Observed

Students solving word problems using a flow chart. The flow chart that each student used consisted of the data, question, operation, equation, and sentence answer.

Comments:

Students were very successful solving word problems using the flow chart. The flow-chart was a valuable visual aide for the children.

Observer

Eleanor Wasser

APPENDIX N

Quick Quiz J

1. Seven girls went hiking. Seven boys joined them on the hike. How many children were hiking?

2. Twelve snakes slithered across the road. The boys chased three snakes away. How many snakes are there now?

3. There were 25 acorns. They were gathered by 5 squirrels. How many acorns did each squirrel gather?

4. The boys swam for twenty minutes. The girls swan for twenty-five minutes. How many minutes longer did the girls swim?

5. There were eight children. Each one ate five marshmallows. How many marshmallows did they eat?

6. Six fish swam by, then eight fish swam by. How many fish swam by?

7. The boys gathered 35 sticks for the fire. The girls gathered 28 sticks. How many fewer sticks did the girls gather?

8. The boys caught 21 fish. They then ate 7 fish. How many fish are there now?

9. There were 24 children. They stayewd in 8 cabins. How many children stayed in each cabin?

10. On the way home six cars were needed to drive them home. Four children went in each car. How many children werre there in all?

APPENDIX O

Observer Form

Date

Activity Observed

Students create word problems using manipulatives.

Comments

The children used dolls and cars to write their own word problems which made the lesson fun and exciting.

Observer

Eleanor Mainor

APPENDIX P

Quick Quiz 4

1. Bob ran six miles. He rested ten minutes and them he ran seven more miles. How many miles did Bob run?

2. Danielle had six packs of lifesavers. Each pack had six lifesavers in it. How many lifesavers did she have?

3. Shannon brought in a package of 60 M&M's. She shared them with six children. How many M&M's did each child receive?

4. Brian went to the store with $1.00. He spent 65¢ on candy. How much change did he receive?

5. When they came to school, Heather had ten pencils and Darrell had twelve pencils. How many more pencils did Darrell have ?

6. Edward cuaght 17 fish. Casey caught 19 fish. How many fewer fish did Edward catch?

7. Amy has collected 32 dolls. She gave 4 dolls to her friend Niki. How many dolls does she have now?

8. Melissa had 35¢. Tricia then gave her 32¢. How much money does Melissa have now?

9. The class has seven fishtanks. Each tank has ten guppies. How many guppies does the class have?

10. There 24 children in the class. The teacher told them to get into 4 teams. How many children were in each team?

APPENDIX Q

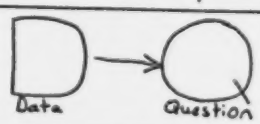
Sample Booklet

My Favorite Story Problems:

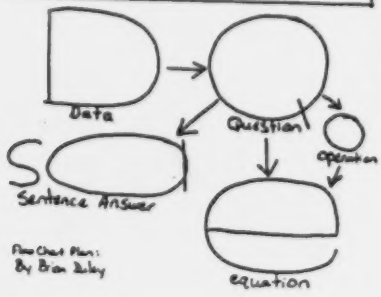
# Solving the Problem of Solving Word Problems

By: Mrs. Bray's Class

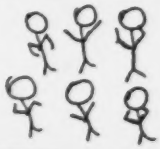
**Step 1: Identifying the Data and Question parts of a word problem.**




**Step 2: Using the Flow Chart plan to work word problems.**

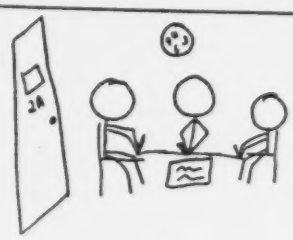



**Step 3: Using manipulatives and the Flow Chart plan to write and solve our own story problems.**



If one student has two arms, how many arms do six students have?

**Step 4: Writing, solving, and rating each others' story problems in small groups.**



APPENDIX R

Teacher-made Post-test

1. John has 137 baseball cards. Sue has 264 baseball cards. How many cards do they have in all?

2. There are 36 students going on a field trip. If only 4 students can go in each car, how many cars will be needed?

3. Jil has a stick of candy 12 inches long. Jennifer has a stick of candy 10 inches long. How much longer is Jill's candy than Jennifer's?

4. Tom ate 5 cheeseburgers. Bobby ate 6 cheeseburgers. How many cheeseburgers did they eat all together?

5. There are 24 children in the class. They have to get into 4 equal teams. How many children should be in each team?

6. The farmer planted watermelon seeds. He planted 6 rows with 6 seeds in each row. How many seeds did he plant?

7. Buddy has baseball practice at 4:00. He practices for 30 minutes. At what time does he finish baseball practice?

8. Joe's dog had 9 puppies. He gave 6 puppies to his friends. How many puppies does Joe have left?

9. The class store has 54 pieces of bubblegum. There are 6 pieces in each bag. How many bags are there?

10. Chris went to Burger King. He bought a cheeseburger for $.65, french fries for $.50, and a small Coke for $.60. How much did Chris spend at Burger King?

11. There were 4 baseball teams at the park. Each team had 6 baseballs. How many baseballs were there in all?

12. Bob weighs 95 pounds. Jim weighs 85 pounds. How much less does Jim weigh than Bob?

13. Ann went to the candy store. She bought 16 gummy bears, 3 candy bars, and 5 pieces of bubblegum. What is sum of the items she bought?

14. Jeff earned $9.00 for helping clean up the yard. He lost $2.00. How much money does he have now?

15. Tom went to the store to buy a new skateboard. It cost $12.00. He gave the clerk $20.00. How much change did he get?

16. There are 9 cars in the parking lot outside the store. If each car has four tires, how many tires do the 9 cars have?

17. Spot, the dog, is 47 inches long. Puff, the cat, is 24 inches long. How much shorter is Puff than Spot?

18. Ann has soccer practice at 5:00. It takes her 30 minutes to walk to practice. What time does Ann leave for practice?

19. Tara has 10 Cabbage Patch Kids. Christy has 11 Cabbage Patch Kids. How many Cabbage Patch Kids do they have together?

20. The red team scored 19 points. The green team scored 13 points. What is the difference between the scores?

APPENDIX S

Evaluative Test Scores

| Student Number | Score Pre-test | Type Error Comp. | Type Error Oper. | Score Quiz 1 | Type Error Comp. | Type Error Oper. | Score Quiz 2 | Type Error Comp. | Type Error Oper. | Score Quiz 3 | Type Error Comp. | Type Error Oper. | Score Quiz 4 | Type Error Comp. | Type Error Oper. | Score Post-test | Type Error Comp. | Type Error Oper. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 60 | 1 | 7 | 90 | 1 | 0 | 70 | 2 | 1 | 80 | 1 | 1 | 80 | 1 | 1 | 90 | 1 | 1 |
| 2 | 95 | 0 | 1 | 100 | 0 | 0 | 90 | 1 | 0 | 100 | 0 | 0 | 90 | 1 | 0 | 95 | 1 | 0 |
| 3 | 70 | 1 | 5 | 70 | 1 | 2 | 80 | 1 | 1 | 80 | 1 | 1 | 80 | 2 | 0 | 85 | 2 | 1 |
| 4 | 80 | 2 | 2 | 90 | 0 | 1 | 70 | 1 | 2 | 80 | 1 | 1 | 90 | 1 | 0 | 90 | 1 | 1 |
| 5 | 30 | 1 | 13 | 10 | 1 | 8 | 30 | 3 | 4 | 40 | 1 | 5 | 50 | 1 | 4 | 60 | 2 | 6 |
| 6 | 75 | 2 | 3 | 70 | 0 | 3 | 90 | 1 | 0 | 90 | 1 | 0 | 90 | 1 | 0 | 85 | 1 | 2 |
| 7 | 80 | 1 | 4 | 90 | 1 | 0 | 70 | 2 | 1 | 90 | 0 | 1 | 80 | 1 | 1 | 85 | 1 | 2 |
| 8 | 90 | 0 | 2 | 100 | 0 | 0 | 90 | 0 | 1 | 90 | 1 | 0 | 100 | 0 | 0 | 100 | 0 | 0 |
| 9 | 65 | 2 | 5 | 40 | 1 | 5 | 40 | 6 | 0 | 80 | 0 | 2 | 80 | 1 | 1 | 80 | 2 | 2 |
| 10 | 85 | 1 | 2 | 80 | 2 | 0 | 90 | 1 | 0 | 100 | 0 | 0 | 80 | 2 | 0 | 90 | 1 | 1 |
| 11 | 60 | 1 | 7 | 70 | 1 | 2 | 80 | 0 | 2 | 80 | 1 | 1 | 100 | 0 | 0 | 95 | 1 | 0 |
| 12 | 75 | 2 | 3 | 50 | 0 | 5 | 40 | 2 | 4 | 90 | 1 | 0 | 90 | 1 | 0 | 85 | 2 | 1 |
| 13 | 40 | 3 | 9 | 70 | 0 | 3 | 40 | 2 | 4 | 80 | 1 | 1 | 80 | 2 | 0 | 80 | 2 | 2 |
| 14 | 75 | 1 | 4 | 70 | 0 | 3 | 50 | 1 | 4 | 70 | 1 | 2 | 90 | 1 | 0 | 80 | 2 | 2 |
| 15 | 35 | 2 | 11 | 70 | 1 | 2 | 80 | 1 | 1 | 80 | 1 | 1 | 90 | 0 | 1 | 85 | 2 | 1 |
| 16 | 65 | 3 | 4 | 60 | 3 | 1 | 60 | 2 | 2 | 90 | 0 | 1 | 100 | 0 | 0 | 85 | 2 | 1 |
| 17 | 40 | 3 | 9 | 70 | 2 | 1 | 90 | 0 | 1 | 100 | 0 | 0 | 90 | 1 | 0 | 90 | 2 | 0 |
| 18 | 60 | 3 | 5 | 20 | 7 | 2 | 40 | 2 | 4 | 70 | 0 | 3 | 80 | 1 | 1 | 80 | 2 | 2 |
| 19 | 75 | 2 | 3 | 90 | 0 | 1 | 70 | 2 | 1 | 70 | 0 | 3 | 80 | 1 | 1 | 80 | 3 | 1 |
| 20 | 65 | 3 | 4 | 70 | 1 | 2 | 80 | 1 | 1 | 80 | 0 | 2 | 80 | 1 | 1 | 80 | 2 | 2 |
| 21 | 35 | 2 | 11 | 20 | 2 | 6 | 50 | 4 | 1 | 60 | 2 | 2 | 80 | 0 | 2 | 80 | 2 | 2 |
| 22 | 30 | 3 | 11 | 20 | 0 | 8 | 40 | 3 | 3 | 60 | 1 | 3 | 60 | 1 | 3 | 70 | 2 | 4 |
| 23 | 75 | 4 | 1 | 30 | 3 | 4 | 40 | 3 | 3 | 60 | 2 | 2 | 90 | 1 | 0 | 80 | 2 | 2 |
| 24 | 70 | 4 | 2 | 80 | 2 | 0 | 80 | 1 | 1 | 90 | 1 | 0 | 90 | 1 | 0 | 90 | 1 | 1 |